North Central Puget Sound Geographic Response Plan Workshop

Sensitive Species Information

The following maps (draft) represent the current knowledge of some of Washington Department of Fisheries' (WDF) trust resources. The maps focus on nearshore resources of high commercial, recreational, or ecological value. **Adult and juvenile life stages of a number of ecologically and economically important species including salmon, marine fish, baitfish, and shellfish as well as the plankton community are considered to be ubiquitous in distribution and therefore, are not displayed on maps.** Pertinent information on many of these species can be found in the habitat association and timing tables which include information on temporal and spatial distribution, preferred habitat, and relative abundance of various life history stages. This information must be considered in resource protection and damage assessments efforts.

Additional areas of resource occurrence are continually being documented. The extent of intertidal spawning habitat represented in the baitfish maps for surf smelt and Pacific sand lance is updated annually as new spawning areas are documented.

The shellfish maps do not offer complete information on intertidal and subtidal shellfish resources. Surveys run by WDF have been oriented to locating beds that could be commercially harvested. Many intertidal areas are privately owned tidelands upon which WDF has not undertaken a comprehensive inventory of the naturally produced or cultured shellfish resources. No attempt has been made on these maps to differentiate between areas which have not been surveyed and those in which shellfish were not found in commercial quantities.

Due to a combination of new data and incomplete data it is not safe to assume that blank areas on the maps are not of concern. If you have any questions regarding this information please contact the WDF Spill Response and Damage Prevention Unit at 206-902-2570.

North Central Puget Sound Geographic Response Plan Workshop
Data Recording Sheet

Resource: Pacific Herring (*Clupea harengus pallasi*)

Resource Information Mapped: Spawning areas.

Resource Use: Human; sport bait fishery targets juvenile fish. Non-human; one of the most important components of the marine food chain; they provide the link between primary production and upper level predators. All life history stages utilized as food by various predators including salmon, rockfish, lingcod, halibut, birds, marine mammals, etc.

General Location or Habitat Association: In this region herring spawning occurs at Similk Bay, Dugalla Bay, Holmes Harbor, Tulalip Bay, and Port Susan. Herring deposit their eggs on marine vegetation, such as eel grass or algae, within the shallow subtidal and intertidal zones.

Seasonal Sensitivity or Occurrence: Adult herring congregate in relatively distinct areas during December through June prior to spawning. Exposure of pre-spawning adults to oil can result in the accumulation of hydrocarbon compounds in the yolk of maturing eggs. Metabolism of these compounds during embryonic and larval stages can result in lethal and sublethal genetic, cellular and morphological injuries. Spawning occurs from February through April. Eggs hatch after approximately 10 days. Larvae and subsequent juvenile fish are found in nearshore areas throughout the following summer. Eggs and larvae are highly susceptible to injury (lethal) from oil exposure.

Recommended Protection Strategy: Utilize open water and nearshore containment and collection techniques to keep oil off of the spawning substrate throughout the region. Use exclusion boom where feasible (Tulalip Bay).

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

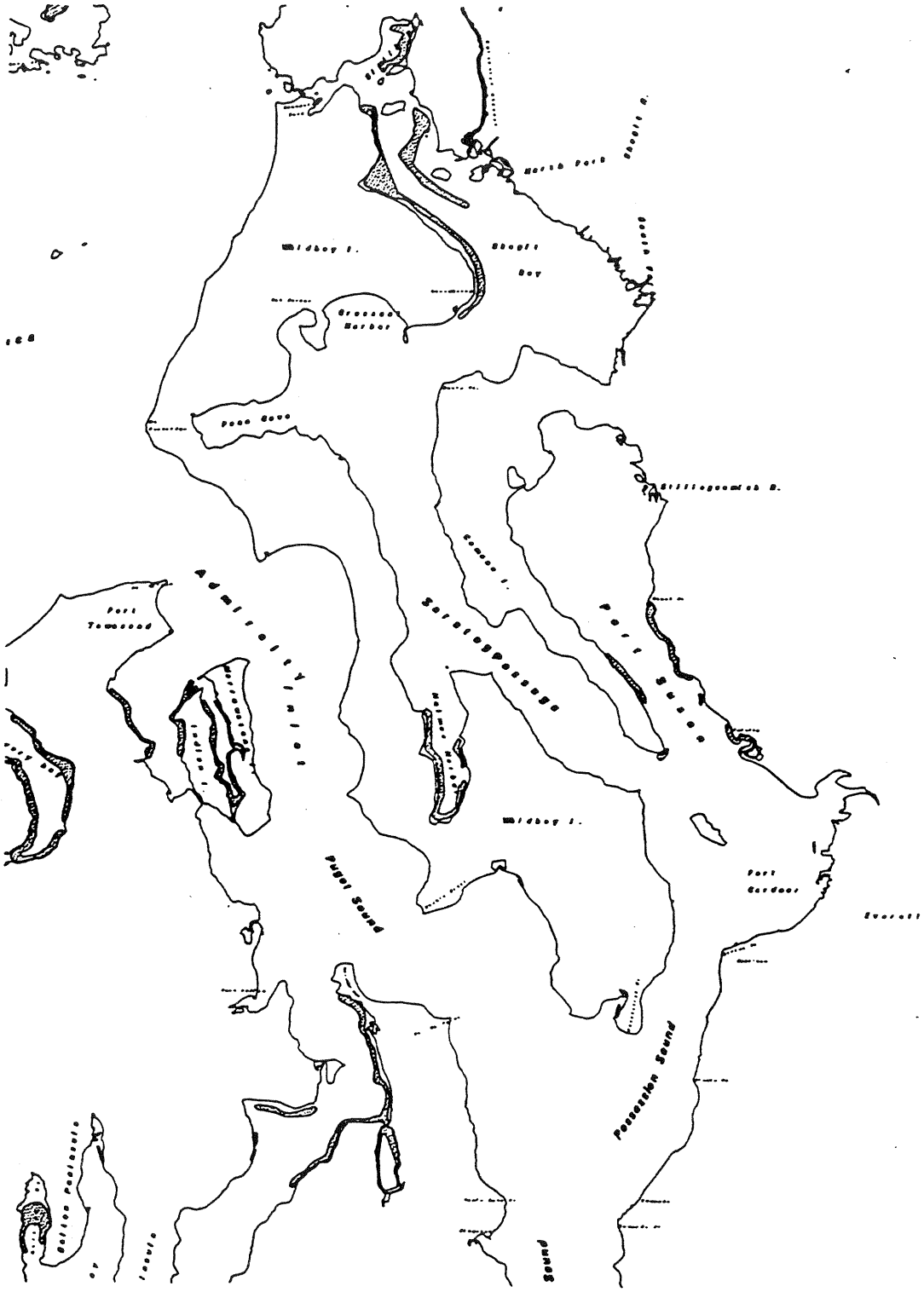
References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

NORTH CENTRAL PUGET SOUND GRP

North Central Puget Sound Baitfish Resources



Herring Spawning

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

February 1, 1995

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop
Data Recording Sheet

Resource: Surf Smelt (*Hypomesus pretiosus*)

Resource Information Mapped: Intertidal surf smelt spawning areas.

Resource Use: Human - commercial and recreational harvest. Non-human - important component of the marine food chain; smelt provide the link between primary production and upper level predators. All life history stages are utilized as food by various predators including salmon, rockfish, lingcod, halibut, birds, marine mammals, etc.

General Location of Sensitive Resource: Surf smelt deposit their eggs in the uppermost intertidal zone on gravel generally having a grain size from 1 to 7 mm. Incubation takes 2 - 4 weeks. Larvae are found in adjacent nearshore surface waters for several weeks following hatching. Spawning areas exist throughout the region (see map). Other undocumented spawning areas are suspected in the region.

Seasonal Sensitivity or Occurrence: Surf smelt spawning occurs in this region from May through October. Eggs and larvae are highly susceptible to injury (lethal) from oil exposure.

Recommended Protection Strategy: Keep oil off of spawning beaches regardless of season. Utilize aggressive open water and nearshore containment and collection techniques to keep oil off of the spawning substrate. Use protection or exclusion boom where feasible.

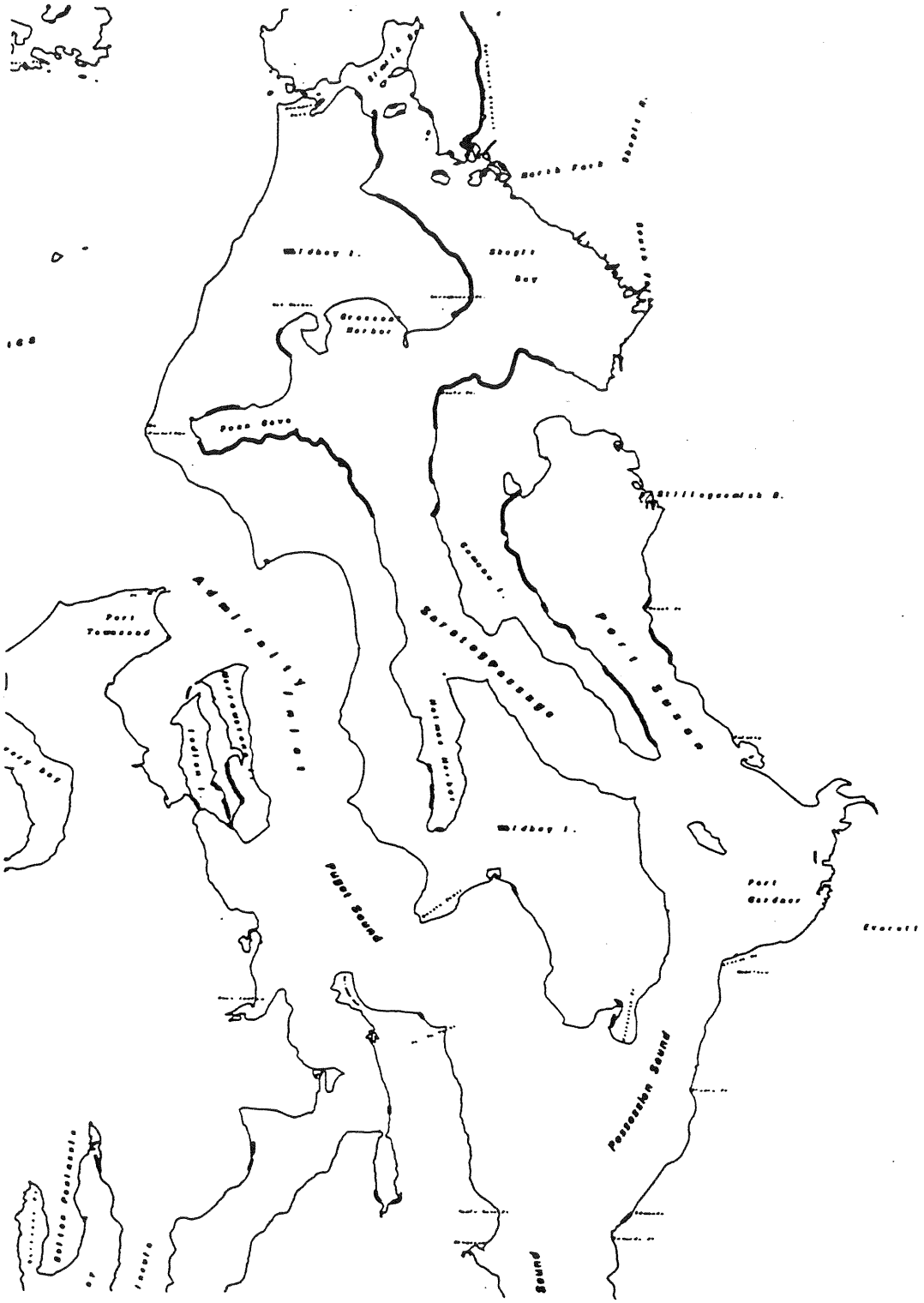
Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

North Central Puget Sound Baitfish Resources



Smelt Spawning

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

February 1, 1995

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop
Data Recording Sheet

Resource: Pacific Sand Lance (*Ammodytes hexapterus*)

Resource Information Mapped: Documented intertidal spawning areas and larval rearing areas.

Resource Use: Human - sand lance are used as bait by recreation fishers. Non-human - important component of the marine food chain; sand lance provide the link between primary production and upper level predators. All life history stages are utilized as food by various predators including salmon, rockfish, lingcod, halibut, birds, marine mammals, etc.

General Location or Habitat Association of Resource: Pacific sand lance spawn from November through February and deposit their eggs on upper intertidal sandy-gravel beaches. Documented spawning areas in the region include Port Susan and the western and northern shores of Camano Island. Sand lance larvae are widespread in the regions near-surface waters from January through March. It is suspected that additional spawning and larval habitat exists within the region. Adult sand lance are found in nearshore habitats throughout the region.

Seasonal Sensitivity: The highest sensitivity is during the spawning and larval stages from October through March. Eggs and larvae are highly susceptible to injury (lethal) from oil exposure.

Recommended Protection Strategy: Keep oil off of spawning beaches regardless of season. Utilize aggressive open water and nearshore containment and collection techniques to keep oil off of the spawning substrate. Use protection or exclusion boom where feasible.

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

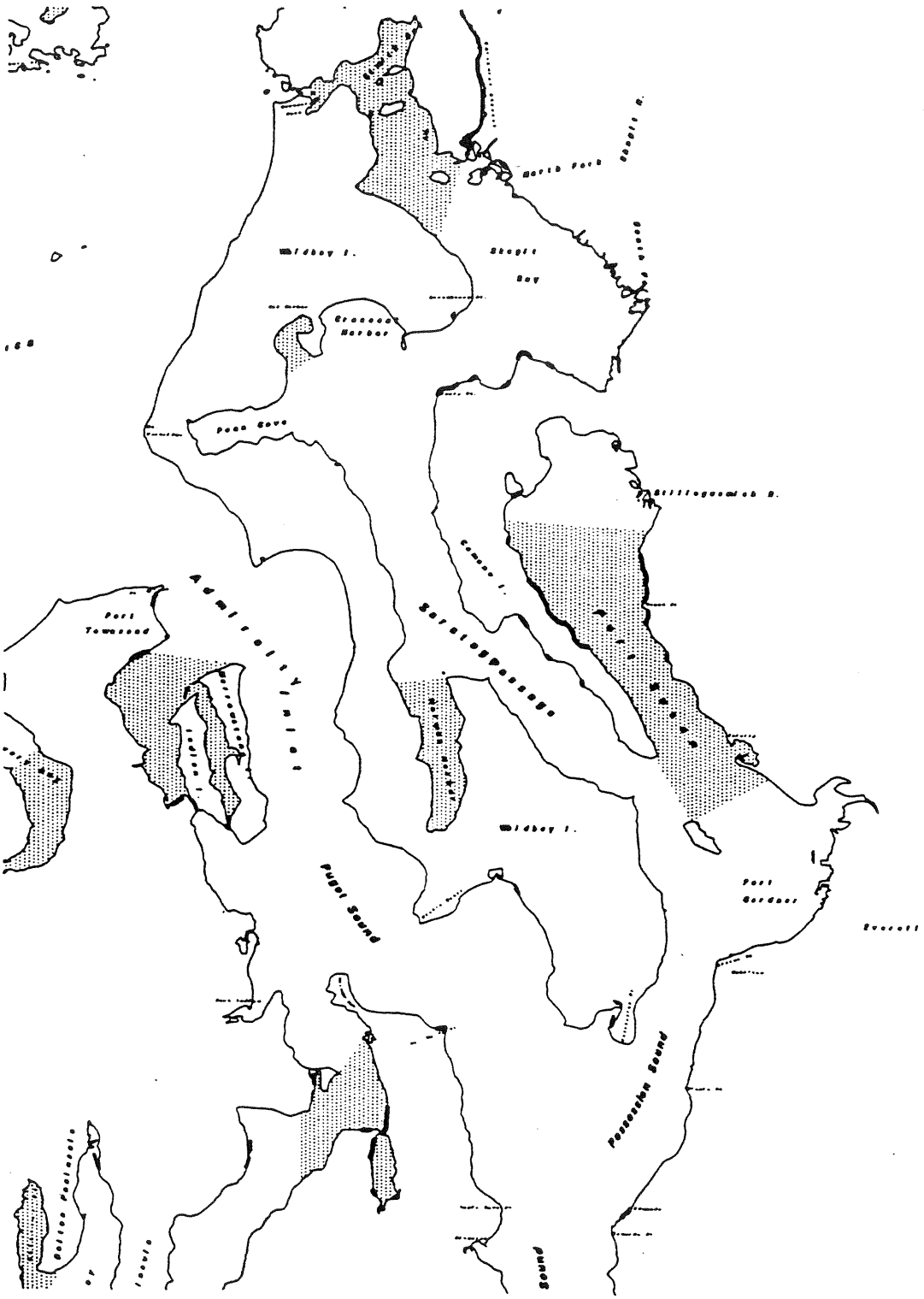
References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

NORTH CENTRAL PUGET SOUND GRP

North Central Puget Sound Baitfish Resources



Sand Lance Spawning

Sand Lance Larvae

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

February 1, 1995

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Rockfish (Sebastes spp.)

Resource Information Mapped: Critical juvenile (young-of-the-year) rockfish habitat.

Resource Use: Human - rockfish are an important commercial and recreational species complex. Non-human - Rockfish are utilized as food organisms by various marine fish species including lingcod and by marine mammals.

General Location or Habitat Association of Resource: High densities of juvenile rockfish are found in nearshore eelgrass and kelp beds. In kelp beds fish are often found within 50 cm of the surface. These habitats are critical to their survival, providing protective cover as well as food. All the eelgrass and kelp beds within the region may provide juvenile habitat. Areas of particular interest include the kelp bed between Edwards Point and Point Wells, kelp and eelgrass beds near Meadowdale, eelgrass beds south of Picnic Point, and kelp beds at Camano Head.

Seasonal Sensitivity: High densities of juvenile rockfish are found in the eelgrass and kelp beds from June through September.

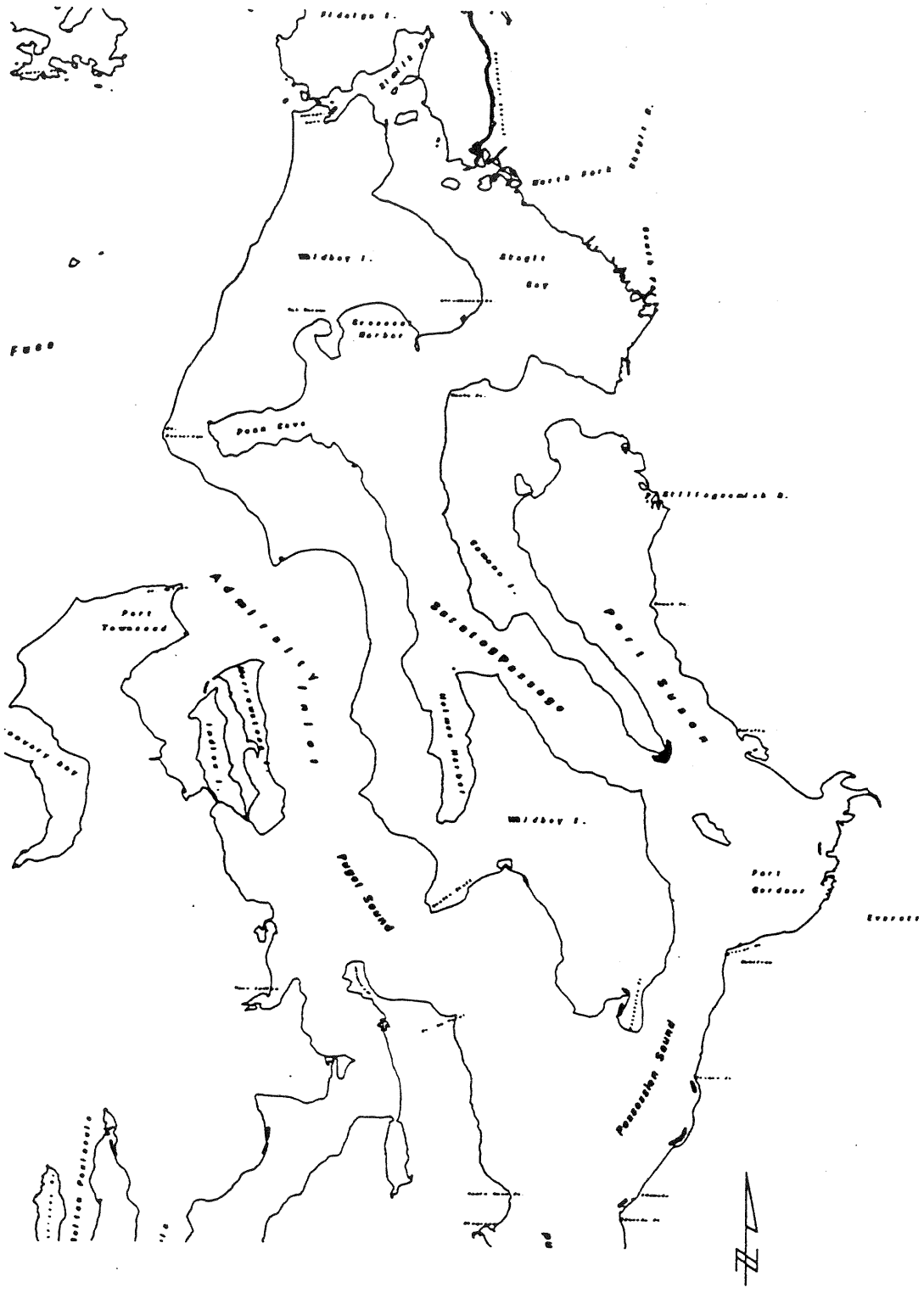
Recommended Protection Strategy: Prevent oil from entering or penetrating into the kelp and eelgrass beds. The beds mentioned above are a high priority for protection. They are small enough that exclusion or deflection booming may protect them.

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit and Marine Habitat Investigations Unit

References:

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

North Central Puget Sound Fish Resources



Juvenile Rockfish Rearing

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

February 1, 1995

Draft - October 27, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Pacific Salmon

Resource Information Mapped: Anadromous streams and rivers utilized by one or more of the following species for spawning and rearing: chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), sockeye (*O. nerka*), chum (*O. keta*), pink (*O. gorbuscha*), and steelhead (*O. mykiss*).

Resource Use: Human; extensive commercial and recreational fisheries. Non-human; the list of predators on the various life history stages of salmon is extensive and includes several species of birds (bald eagle), fish, marine mammals, and terrestrial mammals.

General Location or Habitat Association of Resource: Salmon spawn and rear in all major Washington watersheds and in many of the smaller tributaries. Three major river systems drain into this region, the Skagit River, the Stillaguamish River, and the Snohomish River. Salmon are anadromous in that they begin life in fresh water, spend the largest portion of their life in salt water, then return to fresh water to spawn. There is a broad range of life history types both between and within the species. Both juvenile and adult salmon are present year round throughout this region.

Seasonal Sensitivity: Varies with species, stock, and river system. See habitat association and timing table.

Stock Sensitivity: Skagit stocks; 3 depressed chinook, 1 depressed coho and 1 critical sockeye. Stillaguamish stocks; 2 depressed chinook, 1 depressed coho, and 1 critical steelhead. Snohomish stocks; 2 depressed chinook, one depressed coho, and 1 depressed steelhead.

Recommended Protection Strategy: In the estuaries contain and recover oil in the main channels as close to the entrances as possible or divert to shore based recovery points. Keep oil off of the intertidal flats. Where oil cannot be excluded from the beach use clean up techniques which do not force oil into beach substratum or transport it into the lower intertidal or subtidal zones. Boom the river and stream mouths where extensive tidal influence is present.

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

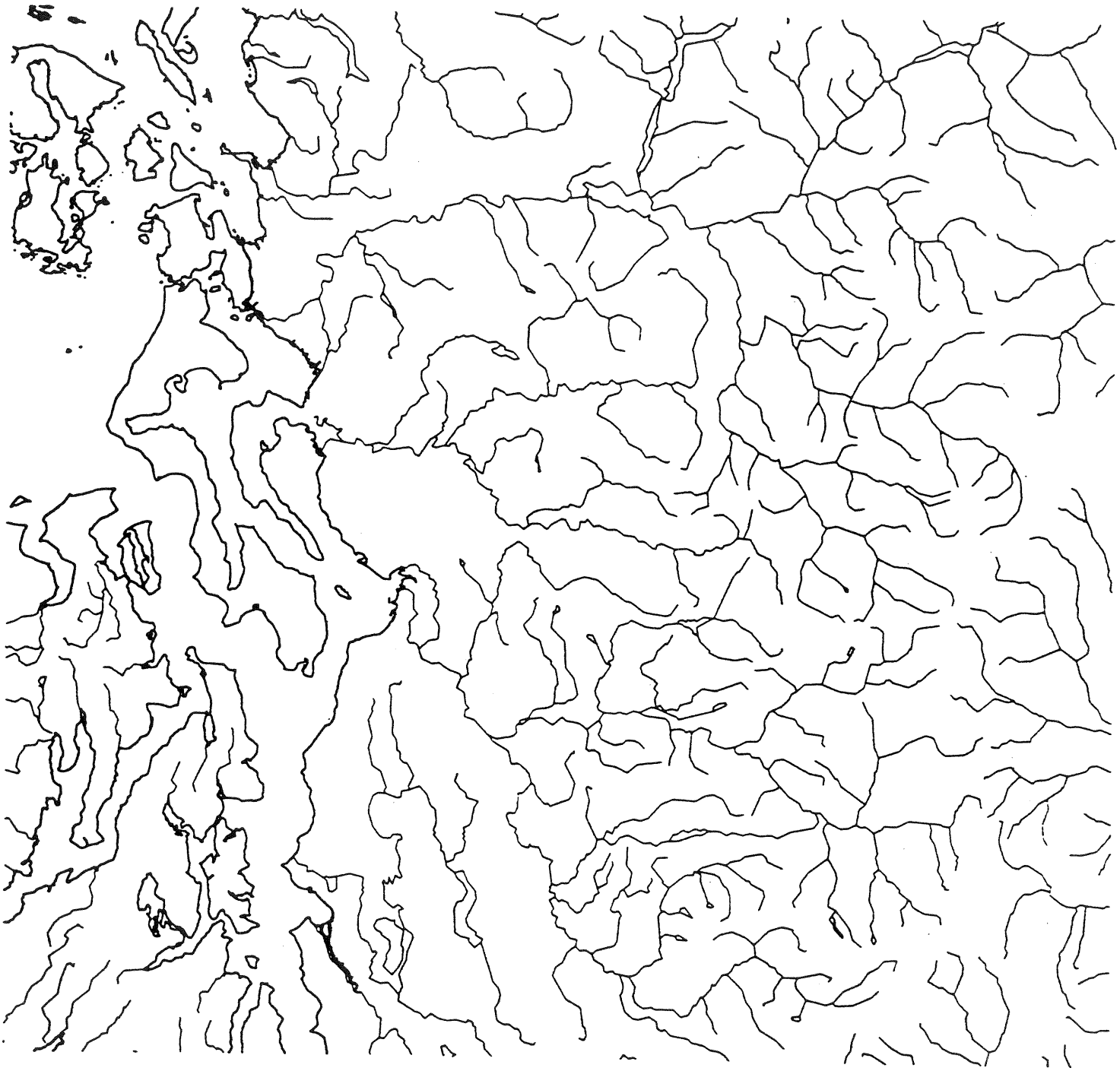
References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

Washington Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes. 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). Olympia, Washington. 212 pp.

North Central Puget Sound Salmon Bearing Rivers



River

USGS Shoreline

Meters

0 20000 40000

Source: Washington Department of Fisheries

February 1, 1995

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Cancer Crab

Resource Information Mapped: Dungeness (*Cancer magister*) and red rock (*C. productus*) crab distribution. Map depicts primarily adults but does cover some juvenile areas. Important juvenile habitat will correlate with the herring spawning (eelgrass) and oyster areas (see appropriate maps).

Resource Use: Human - large commercial and recreational harvest. Non-human - all life history phases are utilized as food by numerous fish species (eg. Pacific herring, lingcod, rockfish, coho and chinook salmon, halibut, English sole and cabezon), octopus, sea otters, harbor seals, sea lions, and gulls.

General Location or Habitat Association of Resource: Cancer crab are found in Similk Bay, Dugalla Bay, Skagit Bay, eastern Saratoga Pass, Port Susan, Port Gardner, and Possession Sound. Adults are found from the intertidal to -90 m MLLW and prefer sandy substrates. Juveniles are found intertidally and typically associated with eelgrass, ulva, bivalve shells, or some form of cover, from +3 to -15 m MLLW. Larvae and megalopae are planktonic. Megalopae are typically found in nearshore waters where they settle to the bottom and metamorphose into juveniles during summer. Females carry incubating eggs beginning in the fall and hatching occurs between February and April.

Seasonal Sensitivity: Larvae/megalopae - planktonic - March through July. Juveniles - epibenthic intertidal - year-round.

Recommended Protection Strategy: Protect nearshore juvenile habitat, particularly eelgrass beds. Utilize protective booming where possible and aggressive open water collection techniques elsewhere.

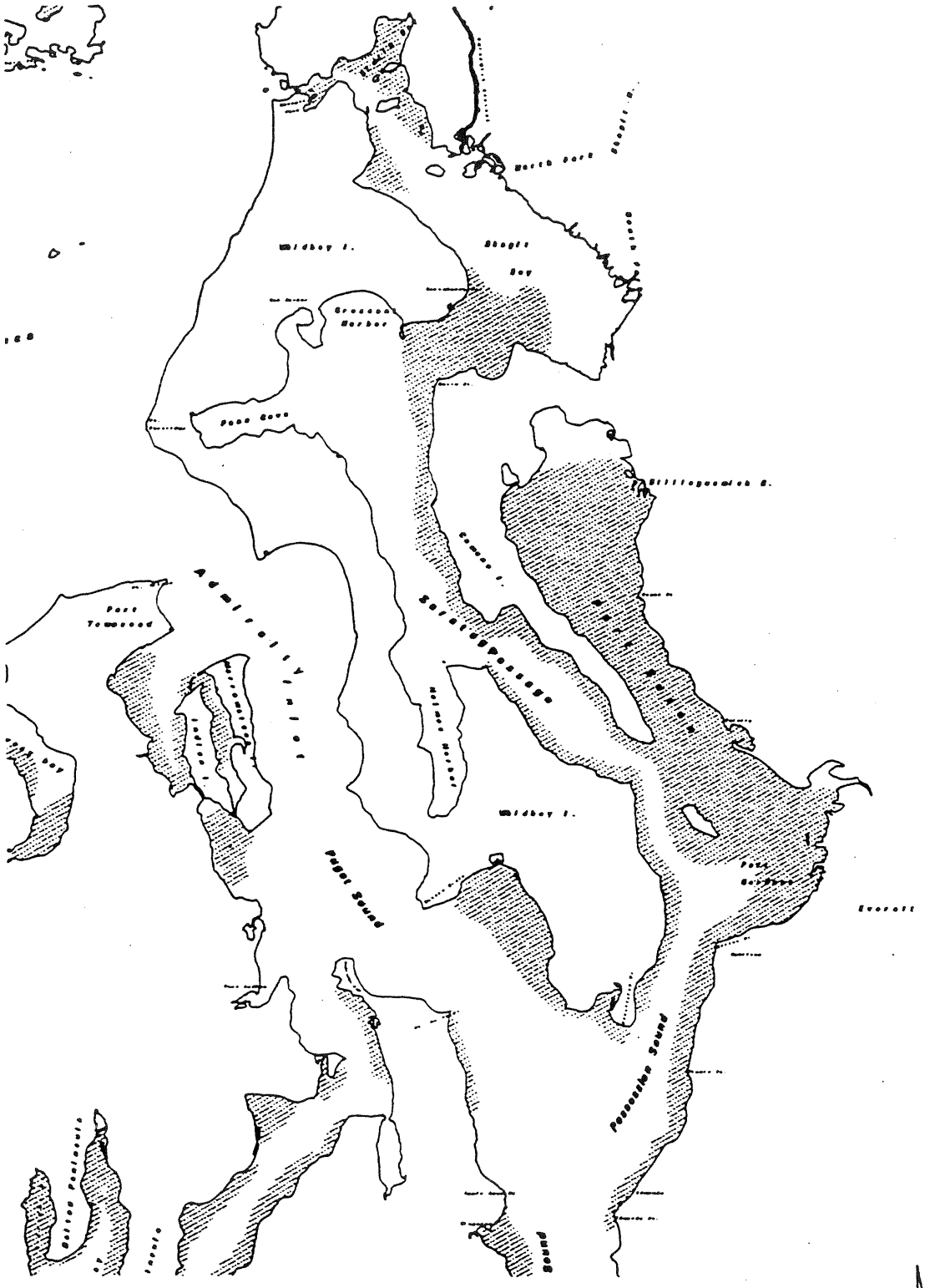
Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

North Central Puget Sound Shellfish Resources



Cancer Crab

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

February 1, 1995

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Intertidal hardshell clams and intertidal softshell clams.

Resource Information Mapped: Hardshell intertidal include the native littleneck (*Protothaca staminea*), the Manila littleneck (*Tapes philippinarum*), butter clams (*Saxidomus giganteus*), piddock clams (*Zirfaea pilsbryi*), and horse clams (*Tresus capax* and *T. nuttallii*), and cockles (*Clinocardium nuttali*). Softshell intertidal includes only the eastern softshell clam (*Mya arenaria*).

Resource Use: Human; commercial and recreational harvest. Non human; as a group clams are feed upon by a wide variety of organisms including snails, sea stars, Dungeness and rock crabs, several species of commercially and recreationally import fish, sea otters, raccoons, scoters and other birds.

General Location or Habitat Association of Resource: Clams are found throughout the region with higher concentrations in Skagit Bay, Dugalla Bay, Cresent Harbor, Penn Cove, Saratoga Pass, and Port Susan. Clams are found from approximately +2 m MLLW in the intertidal zone to subtidal depths of -21 m MLLW.

Seasonal Sensitivity: Due to their sessile lifestyle in the intertidal zone clams are at high risk of exposure throughout the year. Sensitivity would be elevated during the spawning and larval period which can extend from April through October.

Recommended Protection Strategy: Utilize protective booming where possible and aggressive open water collection techniques elsewhere. Where oil cannot be excluded from the beach use clean up techniques which do not force oil into beach substratum.

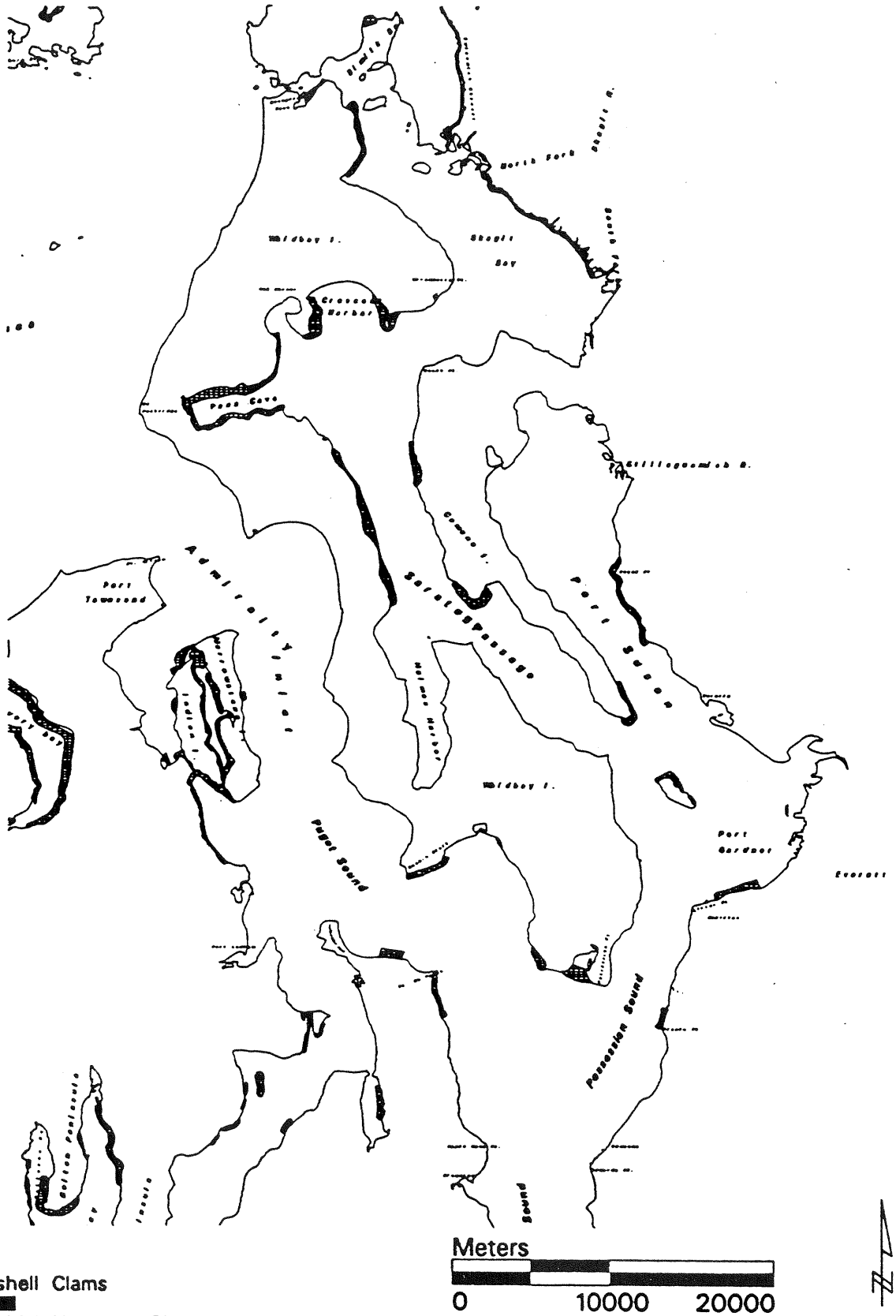
Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

North Central Puget Sound Shellfish Resources



Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Blue Mussel (*Mytilus trossolus*)

Resource Information Mapped: Areas of mussel culture.

Resource Use: Human; mussels are commercially cultured and harvested as well as being recreationally harvested. Non-human; mussels are preyed upon by pile and striped perch, crabs (Cancer sp.), starfish, and scoters. Larvae are eaten by planktivorous fish and invertebrates.

General Location or Habitat Association of Resource: The blue mussel is found between +1.2 m and +3.4 m MLLW attached to rocks, gravel, shell, docks, pilings, and other man-made materials. Mussels are tolerant to a wide range of temperature and salinity. Intensive commercial mussel culture occurs in Penn Cove and Holmes Harbor on Whidbey Island. Naturally occurring mussels are found throughout the region.

Seasonal Sensitivity: Due to their sessile lifestyle in the intertidal zone mussels are at high risk of exposure throughout the year. Sensitivity would be elevated during the spawning and larval period which extends from spring through mid-summer.

Recommended Protection Strategy: For culture operations - exclusion booming. For natural populations - utilize protective booming where possible and aggressive open water and nearshore collection techniques elsewhere. Where oil cannot be excluded from the beach use clean up techniques which do not force oil into beach substratum.

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

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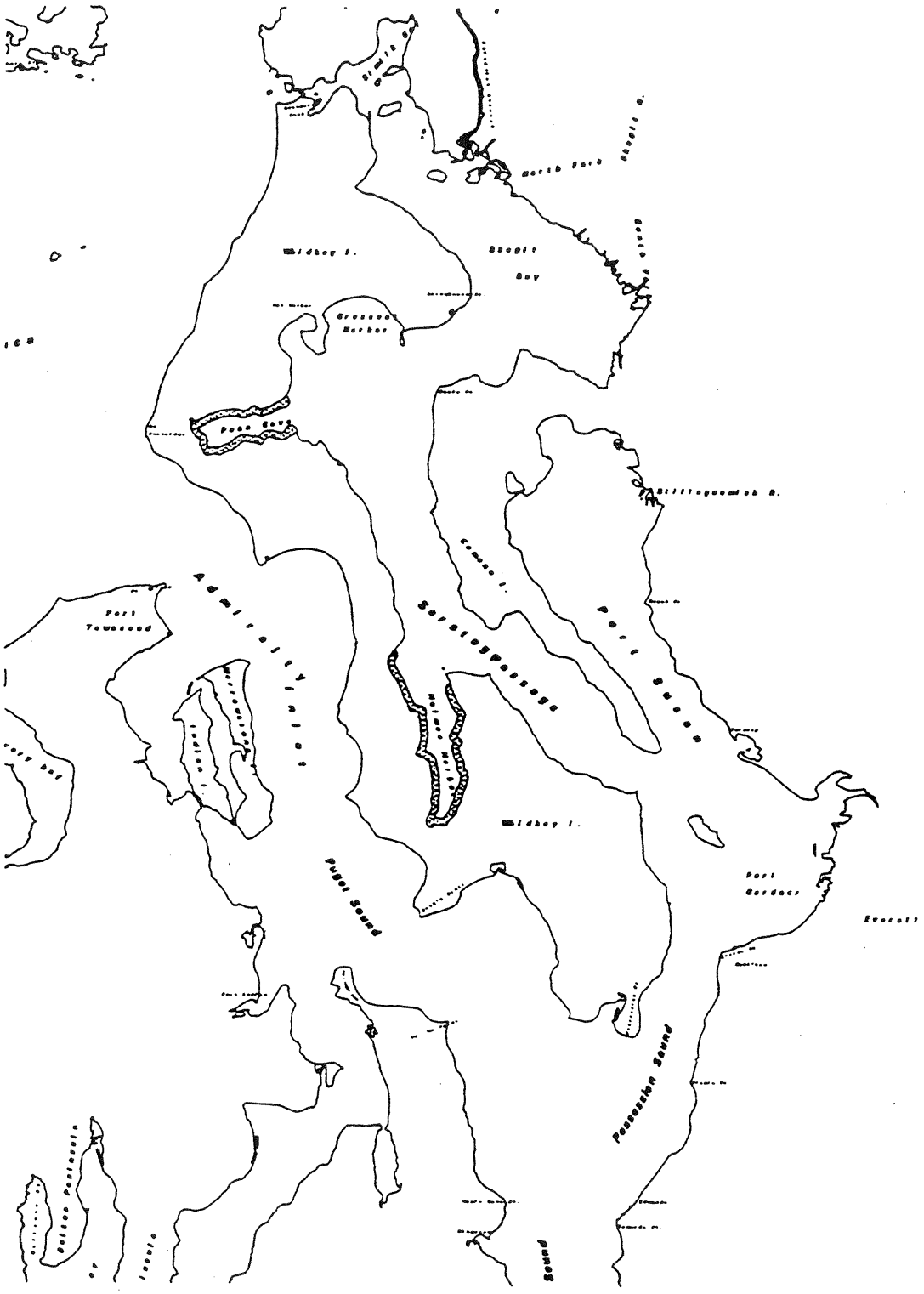
North Central Puget Sound Shellfish Resources



Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

Mussel Culture

USGS Shoreline

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Geoduck Clams (*Panope abrupta*)

Resource Information Mapped: Geoduck clam distribution (commercial quantities).

Resource Use: Human; Geoducks support a large commercial and recreational fisheries. Non human; Geoducks are fed upon by snails, pandalid shrimp, rock crab, English sole, sand sole, rock sole, starry flounder, starfish, and sea otters.

General Location or Habitat Association of Resource: High concentrations of geoducks are found along the eastern side of Whidbey Island from North Bluff to Possession Point. They inhabit depths from +1 to -110 m MLLW and prefer a stable mud and sand substrate.

Seasonal Sensitivity: Sensitivity would be highest during the spawning and larval period from April through August (peak May - July).

Recommended Protection Strategy: Utilize beach clean up techniques which do not transport oil into the subtidal zone.

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries; Volume II: species life history summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD, 329 p.

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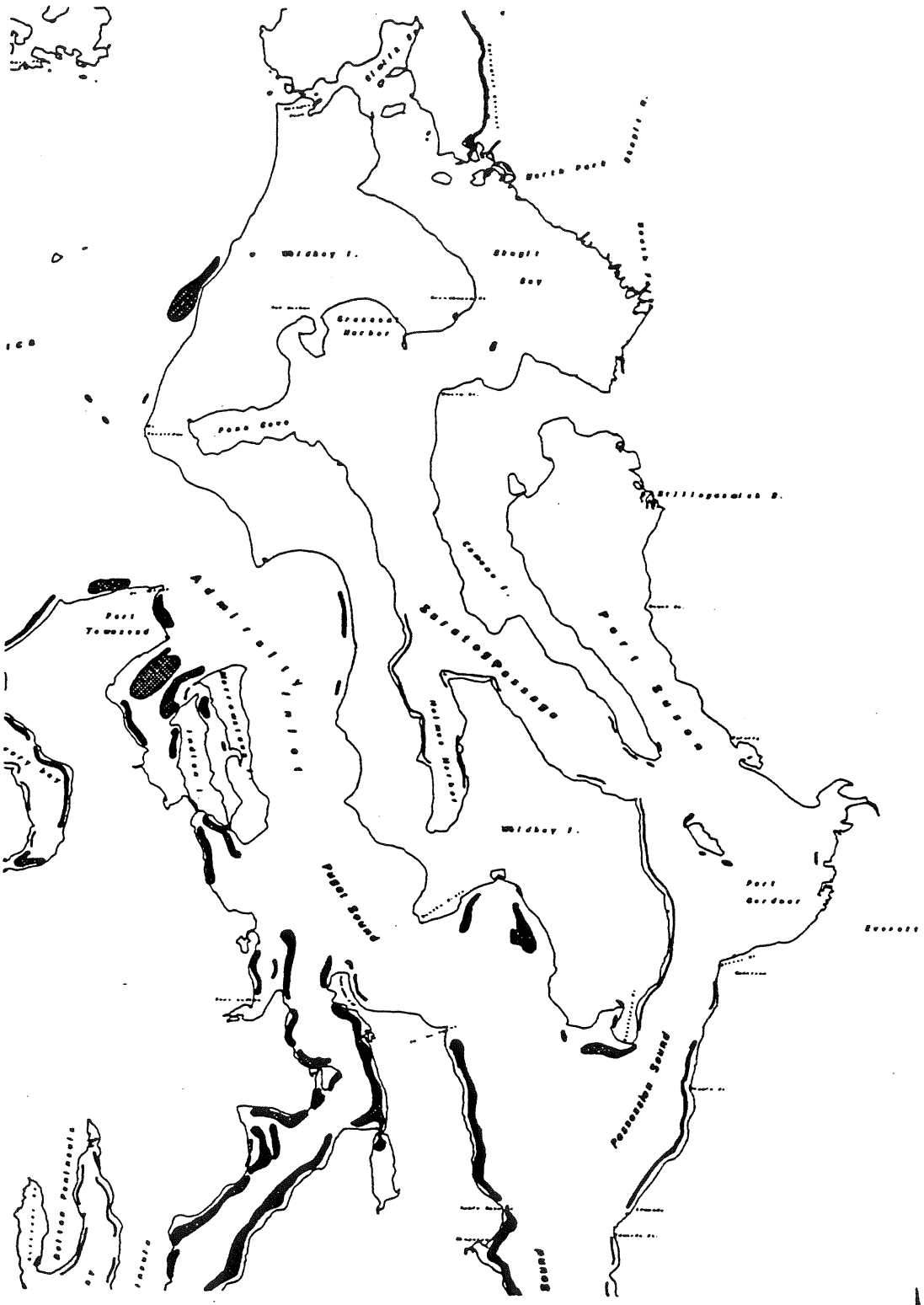
North Central Puget Sound Shellfish Resources



Meters

0 10000 20000

Geoduck Clam

USGS Shoreline

February 1, 1995

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Pandalid Shrimp

Resource Information Mapped: Harvest areas for four species of shrimp including; pink (*Pandalus jordani* and *P. borealis*), coonstripe (*P. danae*), and spot prawn (*P. platyceros*).

Resource Use: Human - commercial and recreational fisheries. Non-human - food organism for many fish species including rockfish, cabezon, and perch.

General Location or Habitat Association of Resource: Most harvest occurs in waters 100 to 220 m deep, however, the coonstripe and spot prawn are found as shallow as the lower intertidal zone. The primary harvest areas in this region are Holmes Harbor, Saratoga Pass, Port Susan, and Possession Sound.

Seasonal Sensitivity: Planktonic larval phase from February through July.

Recommended Protection Strategy: Utilize beach clean up techniques that do not transport oil into shallow subtidal area.

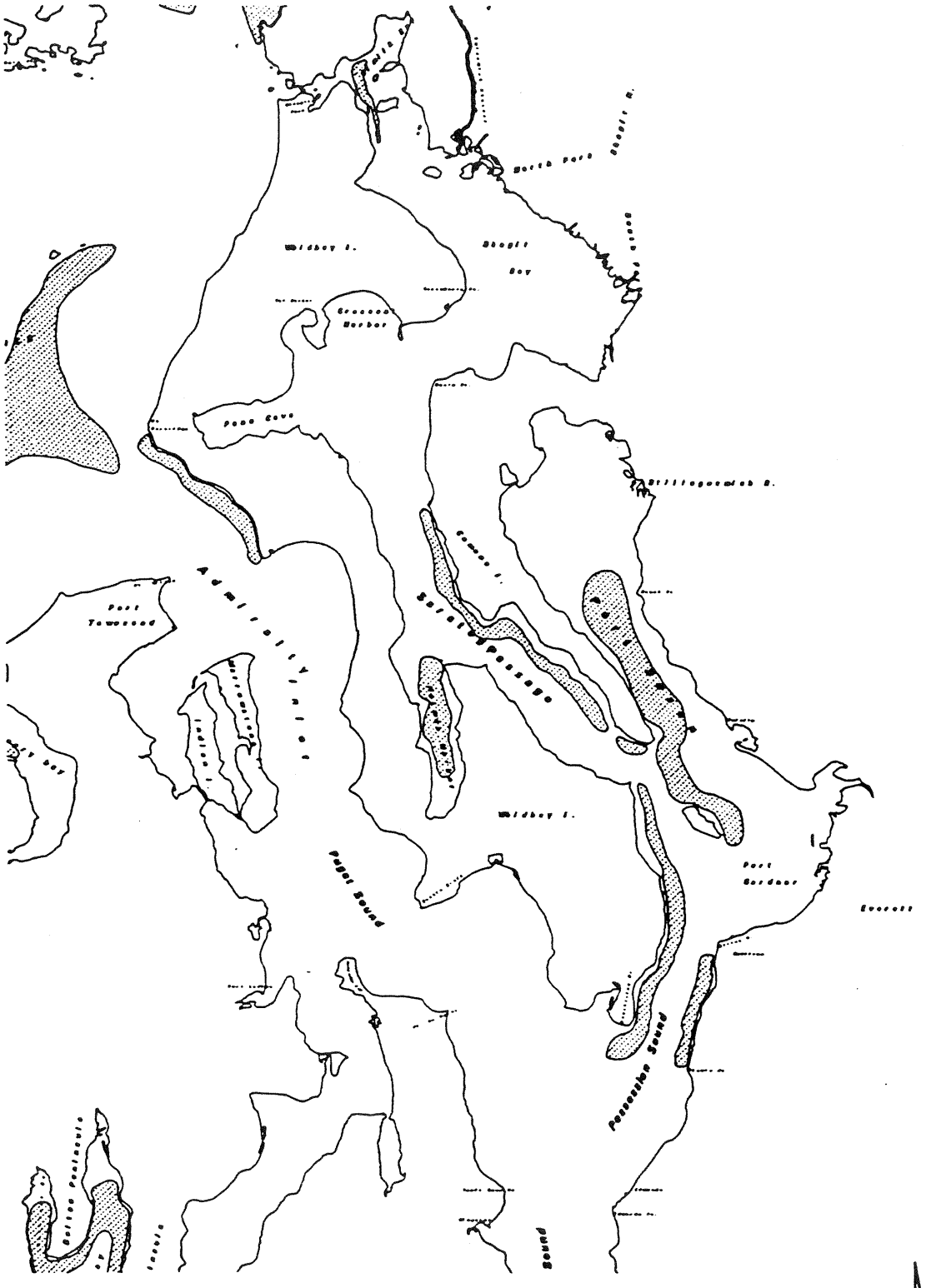
Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

Hueckel, G.J. 1980. Foraging on an artificial reef by three Puget Sound fish species. Wa. Dept. Fish. Tech. Rpt. 53. 110 p.

North Central Puget Sound Shellfish Resources



Pandalid Shrimp

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

Draft - October 18, 1993

North Central Puget Sound Geographic Response Plan Workshop Data Recording Sheet

Resource: Ghost Shrimp (*Callianasa* spp.) and Mud Shrimp (*Upogebia pugettensis*) collectively referred to as burrowing shrimp.

Resource Information Mapped: Commercially harvestable quantities.

Resource Use: Burrowing shrimp are harvested commercially for use as sport fishing bait.

General Location or Habitat Association of Resource: Burrowing shrimp inhabit the tide flats in Port Susan and Saratoga Pass.

Seasonal Sensitivity: Due to their sessile lifestyle in the intertidal zone burrowing shrimp are at high risk of exposure throughout the year. Sensitivity would be elevated during the spawning and larval period which extends from spring through mid-summer.

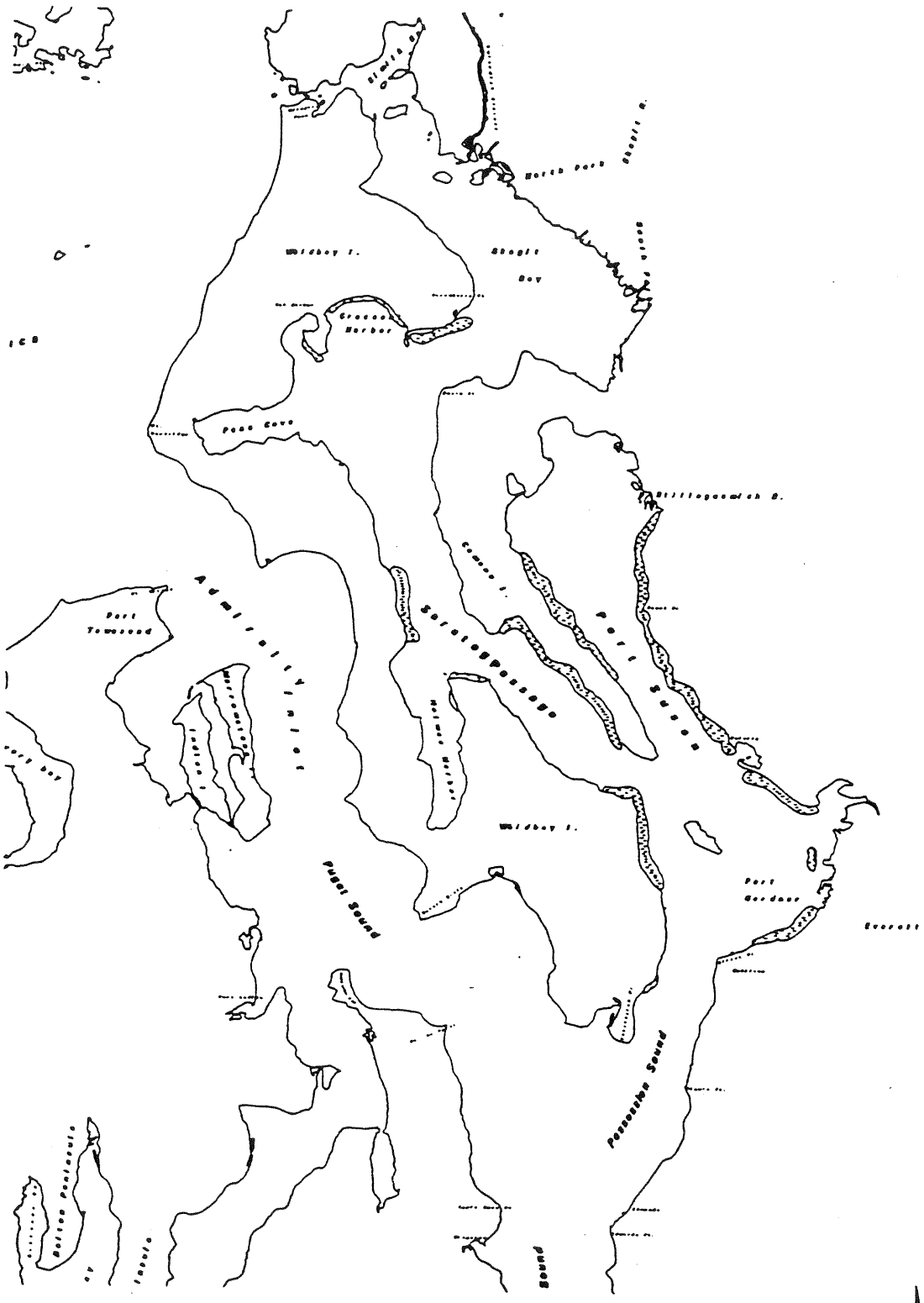
Recommended Protection Strategy: Utilize protective booming where possible and aggressive open water and nearshore collection techniques elsewhere. Where oil cannot be excluded from the beach use clean up techniques which do not force oil into beach substratum.

Information Recorder: WDF - Oil Spill Response and Damage Prevention Unit

References:

Washington Department of Fisheries. 1992. Salmon, marine fish and shellfish resources and associated fisheries in Washington's coastal and inland marine waters. Wa. Dept. Fish. Tech. Rpt. 79. 70 p.

North Central Puget Sound Shellfish Resources



Burrowing Shrimp

USGS Shoreline

Source: Washington Department of Fisheries
This map does not offer complete information on fish and shellfish resource distribution. Comprehensive surveys have not been conducted along all shorelines.

February 1, 1995

Puget Sound Fish and Shellfish Habitat Association Table - Key

Life Stages -

eggs
larvae
juveniles
spawners/spawning
parturition (birth)
adults

Timing -

--- common
+++ abundant
*** highly abundant

Salinity Range -

tidal fresh	0.0 - 0.5	ppt
mixing	0.5 - 25.0	ppt
seawater	>25.0	ppt

Habitats -

intertidal	0-3 m
subtidal	3-10m

Data Source -

Monaco, M.E. et al. 1990. Distribution and abundance of fishes and invertebrates in west coast estuaries. Vol. I: Data summaries. ELMR Rept. 4. Strategic Assessment Branch, NOS/NOAA, Rockville, MD

Emmett, R.L. et al. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries. Vol. II: Species Life History Summaries. ELMR Rept. 8. Strategic Assessment Branch, NOS/NOAA, Rockville, MD

February 1, 1995

NORTH CENTRAL PUGET SOUND GRP

Fish Habitat Association in Puget Sound

Species	Timing	Salinity Range			Substrate Preference									Habitats							
														Type			Area				
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal flat
Spring Chinook Salmon	J F M A M J J A S O N D																			
juveniles	----------++++++++++++++++----	X	X	X		X	X	X								X	X	X	X	X
adults	----++++++++++----	X	X	X		X	X	X								X	X	X	X	X
Fall Chinook Salmon	J F M A M J J A S O N D																			
juveniles	--------++++++++++++----	X	X	X		X	X	X								X	X	X	X	X
adults	------++++++++----	X	X	X		X	X	X								X	X	X	X	X
Sockeye Salmon	J F M A M J J A S O N D																			
juveniles	----++------	X	X	X									X			X	X	X	X	X
adults	--++++----	X	X	X		X	X									X	X	X	X	X
Coho Salmon	J F M A M J J A S O N D																			
juveniles	----++++----------	X	X	X		X	X									X	X	X	X	X
adults	---- ----++++-	X	X	X		X	X									X	X	X	X	X
Chum Salmon	J F M A M J J A S O N D																			
juveniles	--++++**++----------	X	X	X									X			X	X	X	X	X
adults	++------- --++****+	X	X	X		X	X									X	X	X	X	X

Fish Habitat Association in Puget Sound (cont.)

Species	Timing	Salinity Range			Substrate Preference									Habitats							
														Type			Area				
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
Pink Salmon	J F M A M J J A S O N D																			
juveniles	++++*****++----------	X	X	X									X			X	X	X	X	X
adults	--++**++--	X	X	X		X	X									X	X	X	X	X
Surf Smelt	J F M A M J J A S O N D																			
eggs	****** **********		X	X		X								X						
larvae	++++++++ ++++++++++++		X	X		X								X						
juveniles	++++++++++++++++++++++++		X	X									X			X	X	X	X	X
spawners	****** **********		X	X		X								X						
adults	++++++++++++++++++++++++		X	X									X			X	X	X	X	X
Herring	J F M A M J J A S O N D																			
eggs	**********		X	X							X	X		X	X					X
larvae	**********++++		X	X									X			X	X	X	X	X
juveniles	++++++++**********+++++		X	X									X			X	X	X	X	X
spawners	**********		X	X							X	X		X	X					X
adults	**++++++++++++++++++++*		X	X									X			X	X	X	X	

Fish Habitat Association in Puget Sound (cont.)

Species	Timing	Salinity Range			Substrate Preference									Habitats						
														Type			Area			
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
Longfin Smelt	J F M A M J J A S O N D																			
eggs						X											X			
larvae	-------- ---	X	X	X		X										X	X	X	X	
juveniles	----------		X	X									X			X	X	X	X	
adults	-------- ---	X	X	X									X			X	X	X	X	
Anchovy	J F M A M J J A S O N D																			
eggs	--		X	X									X			X				
larvae	----		X	X									X			X	X	X	X	
juveniles	----------		X	X									X			X	X	X	X	
spawners	----		X	X									X			X				
adults	----------		X	X									X			X	X	X	X	
Sand Lance	J F M A M J J A S O N D																			
eggs	******++ ++*		X	X		X								X	X	X	X			
larvae	++********++		X	X		X										X	X			
juveniles	++++++++++******+++++++		X	X		X								X	X	X	X			
spawners	******++ ++*		X	X		X								X	X	X	X			
adults	----------		X	X		X								X	X	X	X			

Fish Habitat Association in Puget Sound (cont.)

Species	Timing	Salinity Range			Substrate Preference									Habitats							
														Type			Area				
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
English Sole	J F M A M J J A S O N D																			
eggs	****** +			X									X							
larvae	++++**++		X	X	X								X			X	X	X		
juveniles	**********		X	X	X	X					X	X		X	X		X	X	X	X
spawning	++++++++++ +		X	X	X	X									X					
adults	++++++++++		X	X	X	X					X	X			X		X			
Starry Flounder	J F M A M J J A S O N D																			
eggs	--------			X									X			X				
larvae	--------		X	X									X			X	X			
juveniles	--------++++++++++---	X	X	X	X	X					X	X		X	X		X	X	X	X
spawning	--++----			X		X														
adults	++++++++++		X	X	X	X					X	X		X	X		X	X		
Ling Cod	J F M A M J J A S O N D																			
eggs	---------- -			X					X	X				X	X					
larvae	----------		X	X									X			X				
juveniles	----------		X	X	X	X			X	X	X	X		X	X		X	X	X	
spawning	------ -			X					X	X				X	X					
adults	----------			X					X	X		X		X	X					

Fish Habitat Association in Puget Sound (cont.)

Species	Timing	Salinity Range			Substrate Preference									Habitats							
														Type			Area				
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
Shiner Perch	J F M A M J J A S O N D																			
juveniles	++++++*******	X	X	X	X	X					X		X		X	X	X	X	X	X
parturition	--++++--		X		X	X					X		X				X	X	X	X
adults	**********		X	X	X	X					X		X		X	X	X	X	X	X
Perch	J F M A M J J A S O N D																			
juveniles	+++******++	X	X	X	X	X					X					X	X	X	X	X
parturition	--+++++++--		X	X	X	X					X						X	X	X	X
adults	--++++++++++--		X	X	X	X					X					X	X	X	X	X
Pacific Tomcod	J F M A M J J A S O N D																			
larvae	--------		X	X									X				X	X	X	
juveniles	----------++++++++++-		X	X	X	X					X	X			X		X	X	X	
adults	++++++++++++++++++++++		X	X	X	X									X		X	X	X	

Shellfish Habitat Association in Puget Sound (cont.)

Species	Timing	Salinity Range			Substrate Preference									Habitats							
														Type			Area				
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
Pacific Gaper Clam	J F M A M J J A S O N D																				
eggs	++++++++++		X	X									X			X	X	X	X	X
larvae	+++++++++++		X	X									X			X	X	X	X	X
juvenile	++++++++++++++++++++++		X	X	X	X								X	X		X	X	X	X
spawning	++++++++++		X	X										X	X		X	X	X	X
adults	++++++++++++++++++++++		X	X	X	X								X	X		X	X	X	X
Horse Clam	J F M A M J J A S O N D																				
eggs	--------												X			X	X	X	X	X
larvae	----------		X	X									X			X	X	X	X	X
juvenile	++++++++++++++++++++++		X	X	X	X								X	X		X	X	X	X
spawning	--------													X	X		X	X	X	X
adults	++++++++++++++++++++++		X	X	X	X								X	X		X	X	X	X
Little Neck Clam	J F M A M J J A S O N D																				
eggs	**********												X			X	X	X	X	X
larvae	**********												X			X	X	X	X	X
juveniles	**********		X	X	X	X	X	X						X	X		X	X	X	X
spawning	**********												X	X	X		X	X	X	X
adults	**********		X	X	X	X	X	X						X	X		X	X	X	X

Shellfish Habitat Association in Puget Sound

Species	Timing	Salinity Range			Substrate Preference									Habitats						
														Type			Area			
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
Dungeness Crab	J F M A M J J A S O N D																			
eggs	----------																			
larvae	----------		X	X									X			X	X	X		
juveniles	----------++****++---		X	X	X	X	X				X			X	X		X	X	X	X
mating	------													X	X					
adults	++++++++++++++++++++++++		X	X	X	X	X							X	X		X	X	X	
Blue Mussel	J F M A M J J A S O N D																			
eggs	++++******++++		X	X									X			X	X	X	X	X
larvae	++++******++++		X	X									X			X	X	X	X	X
juveniles	**********************		X	X				X	X	X				X	X		X	X	X	X
spawning	++++******++++		X	X									X	X	X		X	X	X	X
adults	**********************		X	X				X	X	X				X	X		X	X	X	X
Softshell Clam	J F M A M J J A S O N D																			
eggs	++++++++++		X	X									X			X	X	X	X	X
larvae	++++++++++++		X	X									X			X	X	X	X	X
juvenile	++++++++++++++++++++++++		X	X	X	X								X	X		X	X	X	X
spawning	++++++++++		X	X									X	X	X		X	X	X	X
adults	++++++++++++++++++++++++		X	X	X	X								X	X		X	X	X	X

Shellfish Habitat Association in Puget Sound (cont.)

Species	Timing	Salinity Range			Substrate Preference									Habitats						
														Type			Area			
		Tidal Fresh	Mixing	Seawater	Mud/Silt/Clay	Sand/Granule	Pebble	Cobble	Boulder/Riprap	Rocky Outcrop	Estuarine Veg	Marine Veg	None	Benthic Intertidal	Benthic Subtidal	Pelagic	Mainstem Channel	Subsidiary Channel	Channel Edge	Intertidal Flat
Manila Clam	J F M A M J J A S O N D																			
eggs	**********												X			X	X	X	X	X
larvae	**********		X	X									X			X	X	X	X	X
juveniles	**********		X	X	X	X	X	X						X	X				X	X
spawning	**********												X	X	X				X	X
adults	**********		X	X	X	X	X	X						X	X				X	X
Pacific Oyster	J F M A M J J A S O N D																			
eggs													X			X	X	X	X	X
larvae													X			X	X	X	X	X
juveniles	**********		X	X	X	X	X	X	X	X				X	X		X	X	X	X
adults	**********		X	X	X	X	X	X	X	X				X	X		X	X	X	X
Geoduck Clam	J F M A M J J A S O N D																			
eggs	++++++++		X	X									X			X	X	X	X	X
larvae	++++++++++		X	X									X			X	X	X	X	X
juveniles	++++++++++		X	X	X	X								X	X		X	X	X	X
spawning	++++++++		X	X									X	X	X		X	X	X	X
adults	++++++++++		X	X	X	X								X	X		X	X	X	X